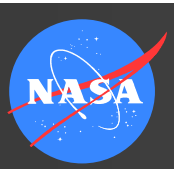

NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION

NASA's Earth Science Data Systems Standards Process
"A Strategy to Adopt Standards that Work"

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Conclusions

- The SPG strategy to encourage the adoption of community based standards is working
  - NASA Earth science data management can rely on standards to achieve highest priority interoperability
  - Science investigators are assured that standards contribute to science success and interoperability within their discipline
  - “Downstream users” have well documented path to use data.
- Three separate initiatives are started
  - OPeNDAP as transport standard for ocean science data products.
  - A science content standard for remote sensing precipitation products.
  - Expanded use of FGDC vegetation classification system.
- We are seeking additional community leadership!

Review

- Data Systems contribution to science and applications face obstacles:
  - Heterogeneous sensors, platforms sources, projects, campaigns
  - Inconstant content, multiple formats, disparate projections, etc.
  - Multiple models for search, discovery, packaging and delivery of data
- Data Systems Standards Needs: INTEROPERABILITY
  - Scientific necessity for consistent data content.
  - Engineeringbenefit to limiting the range of encoding (that is the number of different formats).
  - Operational benefit to use of common protocols for discovery and interchange.
  - User benefit to providing science data to downstream analysis and applications using consistent content, encoding and interface protocols.

Insights

- Interoperability does not require homogeneous systems, but rather coordination at the interfaces.
- Management can judge success based upon program goals rather than dictate solutions.
  - example: degree of interoperability rather than use of particular data format.
- Communities of practice have solutions.
- Published practices that demonstrate benefit can grow …
  - successful practice in specific community
  - broader community adoption
  - community-recognized “standards”

The ESDSWG Standards Process

- Modeled on Internet Engineering Task Force “RFC” process and tailored to meet NASA’s circumstances. The standards process provides:
  - Credibility - "peer" and "stakeholder" review of proposed standards will establish trust that standards are sound.
  - Transparency - within NASA and allied communities, the progress of standards decisions will be evident
  - Workability - implementation examples and evidence of operational success will encourage adoption of standards that are known to work
  - Timeliness - standards adoption will keep up with technological innovation and fit into the schedule needs of missions.
  - Relevance - standards will be responsive to NASA mission, science and data systems requirements
  - Potential wider use of standard outside of proposing community

Standards Process Group Strategy

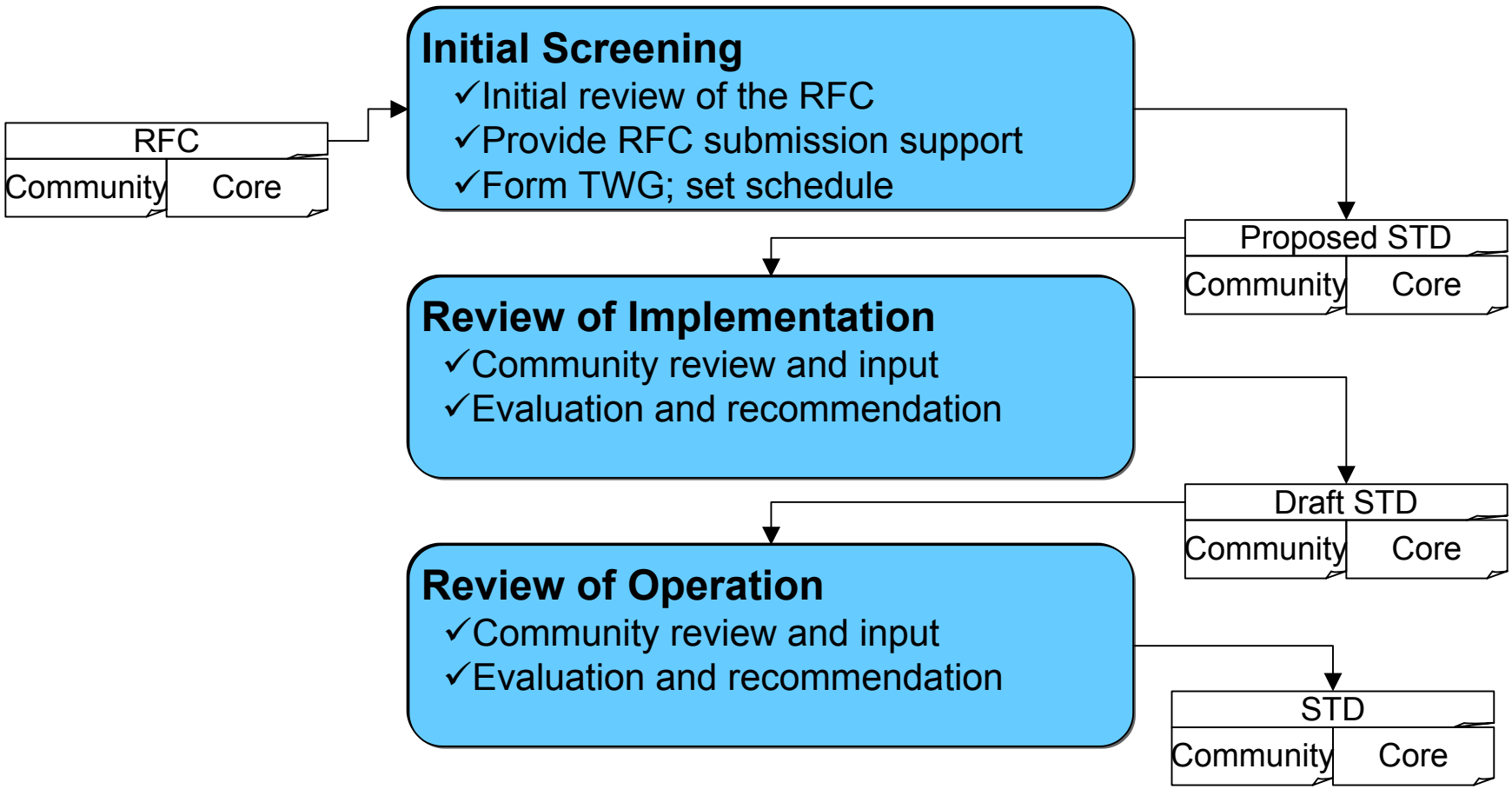
- Adopt standards at the interfaces, appropriate to given science and drawn from successful practice.
- i.e. “a strategy to adopt standards that work”.
  - Adoption, not development.
  - Demonstrated implementation feasibility.
  - Demonstrated operational benefit.
  - Nominated and endorsed by “communities of practice”.

- Consequence of standard
  - Future NASA data systems component proposals will be judged partly on how well they interoperate using community-identified practices or else justify why departure from community has greater benefit.

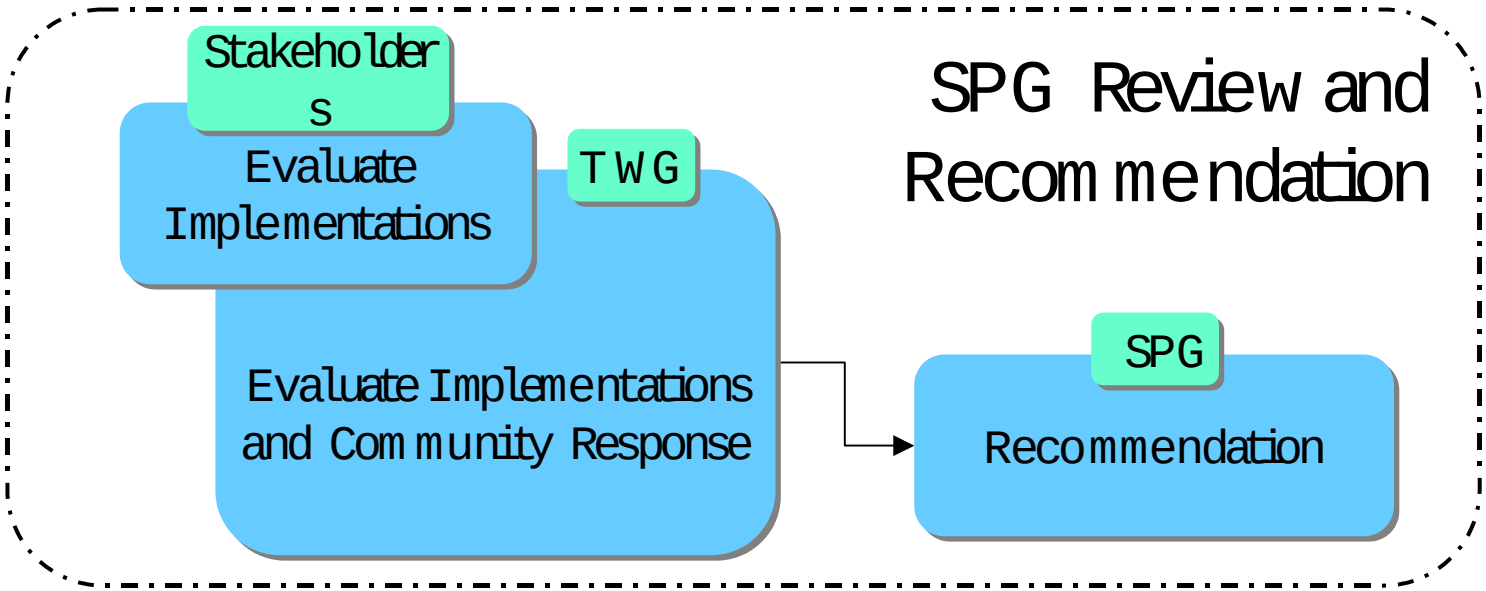
Benefits

- Registers community practice for NASA
  - NASA Earth science data management can rely on standards to achieve highest priority interoperability
- Encourages consensus within communities
  - Science investigators are assured that standards contribute to science success in their discipline.
- Grows use of common practices among related activities
  - Discipline communities benefit from the expertise gained by others
- Documents data systems practices for use by external communities.
  - Lowers barriers to entry and use of NASA data.

Three Step Standards Process



SPG Review


Stakeholders
Evaluate Implementations
TWG
Evaluate Implementations and Community Response
SPG Review and Recommendation
SPG
Recommendation

Sources of RFC

- Solicited
  - Agency, program, project, science team, or other identifies requirement for a standard.
  - SPG evaluates requirements and determines applicability
  - SPG Issues RFI to get community input if needed
  - If response indicates need to develop, SPG recommends development
  - If response indicates existing standard meets requirement, SPG assigns stakeholder to write an RFC
- "Unsolicited"
  - THE PREFERRED SOURCE
  - Stakeholder identifies standard for use by community.
  - Stakeholder writes RFC

- RFC Document
  - New or adopted standard or profile of standard.
  - Specific application.
  - Implementation relevant to Earth science data systems (must have at least one operational implementation)

What's in the works

- DAP 2 standard – used by many in the oceanographic community – basis for the DODS and OpenDAP servers. -- submitted in June as a "Community Standard"
  - "Request For Comments" on implementation experience distributed October 1, comments due November 12.
- Precipitation Community – discussing potential science content standards being used to define level 2 & level 3 data
  - Self identified group of precipitation scientists have identified need and are proposing a draft. Are discussing at IPWG in Monterey.
  - "The community is establishing de facto standards in this area and that is the best way to deal with this."
- FGDC Vegetation Index standard – discussing with potential community members

Community Leadership

- Strong proposals will have:
  - Leadership to support and use standard
  - Potential for impact
  - Potential for approval
  - Simple standard is better
  - Potential for spillover to other communities
- Successful RFCs will have:
  - At least two implementers
  - Demonstrated operational benefit
  - Leadership in generating the RFC
  - Community willing/able to review

Benefits

- Register community practice for NASA
  - NASA Earth science data management can rely on standards to achieve highest priority interoperability
- Encourage consensus within communities
  - Science investigators are assured that standards contribute to science success in their discipline
- Grow use of common practices among related activities
  - Discipline communities benefit from the expertise gained by others
- Document data systems practices for use by external communities.

Breakout Sessions

- DAP 2 Potential Topics
  - potential impacts if DAP 2 is adopted as a community standard?
  - Is the DAP 2 a potential future core standard?
- FGDC Lessons Learned Potential Topics
  - How to identify community needs?
  - How to evaluate the benefits of standardization?
- Potential General Topics
  - Ways to energize science/measurement communities?
  - The scope of “standards”: data format, communication protocol, software technologies, network techniques, others?
  - What are driving needs of each of the ESE communities for data systems?
  - What kinds of community standards are most needed ?

Contacts

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BACKUP SLIDES

RFCs

Classification and Expectations

Classification of RFCs

- Technical Notes – contains technical information relevant to Earth science data systems activities but not considered to be standards
- Standards Track RFCs – proposed standards that could be promoted to “Standard” after going through the ESDSWG Standards Process
  - Proposed Standard
  - Draft Standard
  - Standard
- Core Standard – mandatory if applicable
- Community Standard – recommended by self formed communities but not required by NASA.

Core and community standards

- Core standard:
  - When this standard is applicable, it applies to all NASA funded projects.
  - A minimal set of core standards at key interoperability capabilities are expected.
  - NASA requires use unless justified not to.
- Community standard:
  - Registered with the standards process by self-formed communities.
  - Encourages adoption by others because of publication.
  - Adhered to by community but not necessarily required by NASA.

What is expected of a Standards Submitter

- Develop one or a series of RFCs.
- Show example implementations.
- Submit RFC using SPG guidelines.
- Provide a liaison to the SPG and TWG.
- Provide list of key community reviewers.

What is expected of the standards process?

- Help Submitter develop RFCs and navigate process.
- The standards process itself.
  - Constitute the TWG
  - Coordinate public comments from key stakeholders
  - Broader review
- Publication and promotion of standard.

EVOLUTION

The Standards Process contribution

Evolution From:

- As-is systems & management are of two kinds:
  - 1. Management to strict requirements baseline with general cross-cutting services provided by a large project responsive to prioritized requirements derived from a wide range of customers. (economy of scale)
  - 2. Management to flexibly-traded requirements with tailored, high value services provided by a small project responsive to specific community of defined costumers. (economy of purpose)
- Few bridges between the two approaches.
- Neither provides flexibility to support novel activities outside a particular project's given scope.

Evolution Toward:

- Responsiveness to defined communities, services to broad community.
- Cross-cutting basic services that do not require central management.
- Ability to add new data system components, independently managed.

Future Data Systems Features

- Measurement based rather than mission or instrument based.
- Selection and management will emphasize flexibility and accountability over centralization.
- More distributed geographically, functionally and managerially.
- Diversity in implementation will be encouraged with coordination at the interfaces.

The Strategy

- Working groups bring community expertise to bear in practical application.
- NASA management accepts recommendations with demonstrated benefit.
  - Apply strictly to future procurement/development.
  - Apply loosely to systems in maintenance.
- Data systems developers manage independent systems, and provide standard interfaces.

ESDWG SPG Contribution to Strategy

- Adopt standards at the interfaces, appropriate to given science and drawn from successful practice.
- Facilitate “clone and own” reuse of systems and components and collaborative “open source” development and maintenance.
- Accelerate technology infusion while reducing risk of adoption of demonstrated technologies.
- Define metrics that reflect both effectiveness in serving core constituency and participation in cross-cutting elements

Standards Process Group Strategy

- Adopt standards at the interfaces, appropriate to given science and drawn from successful practice.
- i.e. “a strategy to adopt standards that work”.
  - Adoption, not development.
  - Demonstrated implementation feasibility.
  - Demonstrated operational benefit.
  - Endorsement by “community of practice”.
- Consequence of standard
  - Future NASA data systems component proposals will be judged partly on how well they use of appropriate standards or else justify why departure from standard is necessary.

Characteristics of Process

- Dynamic
  - In areas where there are competing standards and/or without demonstrated operational benefit, standards may remain in, and be useable as "draft".
  - Even when the technology is proven (i.e. has gained "standard" status), there is understanding that the use of a given standard by a particular funded activity may not be appropriate.
- Community driven
  - Relies on community experience and advocacy.
  - Standards will grow out of practices rather than to be developed by expert committee and imposed.
- Advisory
  - The decisions of the SPG are recommendations.
  - Advancement of a standard is a management decision.

Impact to Data Systems

- The adoption of interoperability standards will benefit the future evolution of NASA Earth science data systems:
  - Lower Cost - Adoption of standards results in lower costs for data system maintenance and replacement cycles.
  - Lower Risk - Adoption of proven standards assures that NASA data systems continue to be effective.
  - Greater Flexibility - Standards establish interoperability among NASA data systems analogous to “plug-and-play”.
  - Greater Innovation - Standards for data systems mean that NASA activities can pursue science and application innovation.

SEEDS Context

- Some principles and assumptions expressed in the SEEDS pre-formulation document, in interviews with stakeholders and in public workshops:
  - NASA data systems future selection and management will emphasize flexibility and accountability over centralization.
  - Diversity in Earth science data systems implementation will be encouraged with coordination at the interfaces.
  - Future systems will be more distributed geographically, functionally and managerially.
  - Standards are available, NASA need not develop unique standards, but rather adopt appropriate standards by drawing on technical expertise from the wider Earth science community.
  - There are no one-size-fits-all standards. Different communities of use require different standards.
  - NASA should only mandate use of standards that have been shown to work in the NASA context.

THE PROCESS

History and description

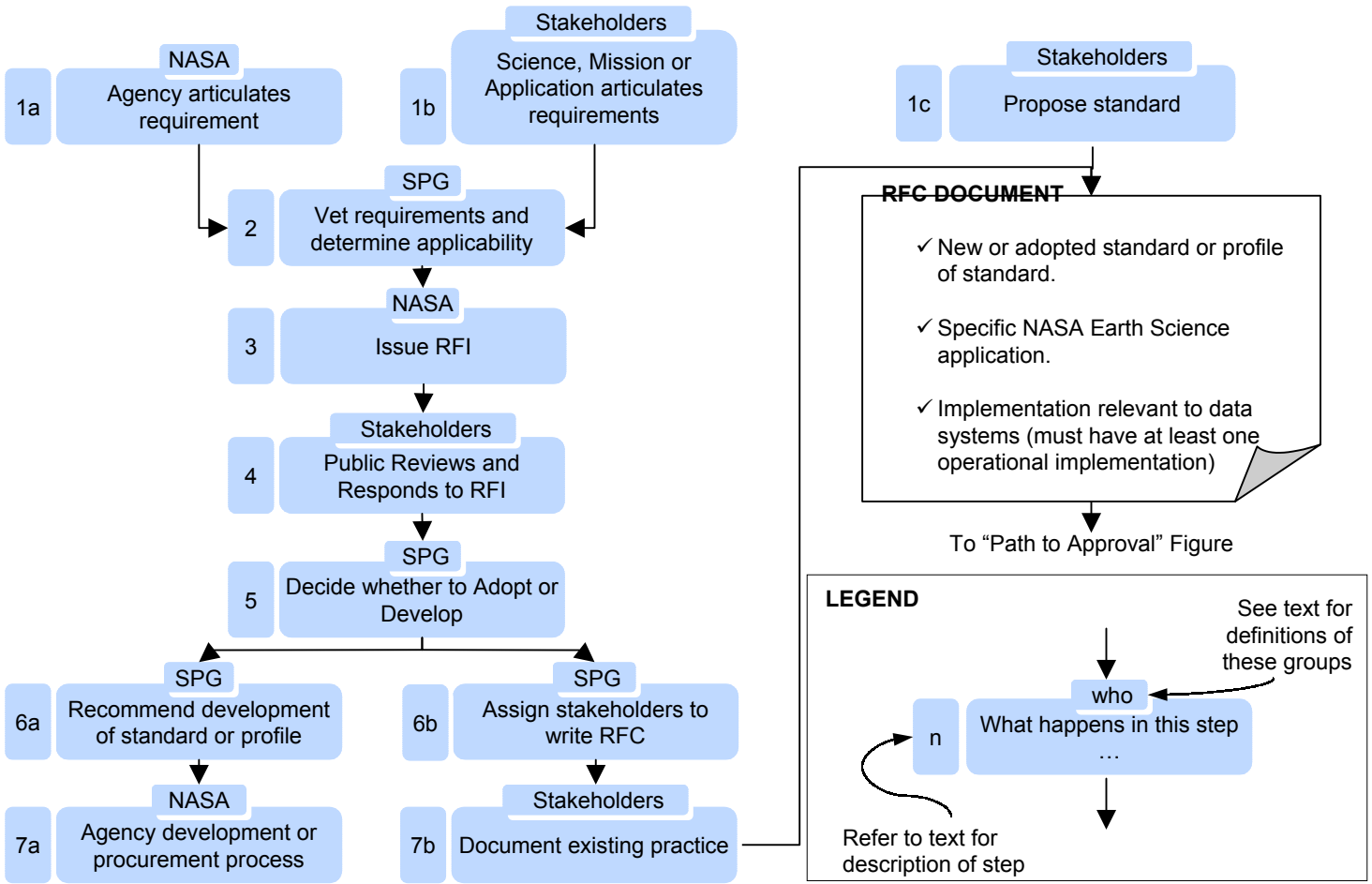
Process Model Comparisons

- The SEEDS study examined several models for standards development and adoption. These included ISO TC211, OGC, W3C, CCSDS, FGDC and IETF. The team recommended building an NASA Earth science standards process based on Internet Engineering Task Force (IETF) model. IETF benefits:
  - Openness
  - Potential for speedy decision-making
  - Emphasis on working implementations
  - Simple, effective, open documentation practices
  - Consensus decision making
  - History of success of Internet validates model for information interface standards.

Tailoring for NASA

- Data systems for NASA Earth science have additional requirements. To accommodate NASA needs, the IETF example is modified to better reflect:
  - Timeliness: NASA data systems developers work to a schedule. Standards decisions must support mission schedules.
  - Resource Impacts: Adoption of standards may involve costs that are outside a mission's profile. Standards cannot be imposed if there are insufficient resources.
  - Accountability: A consultative process cannot bind the agency to use of particular standard. Policy decisions must be made by NASA management.

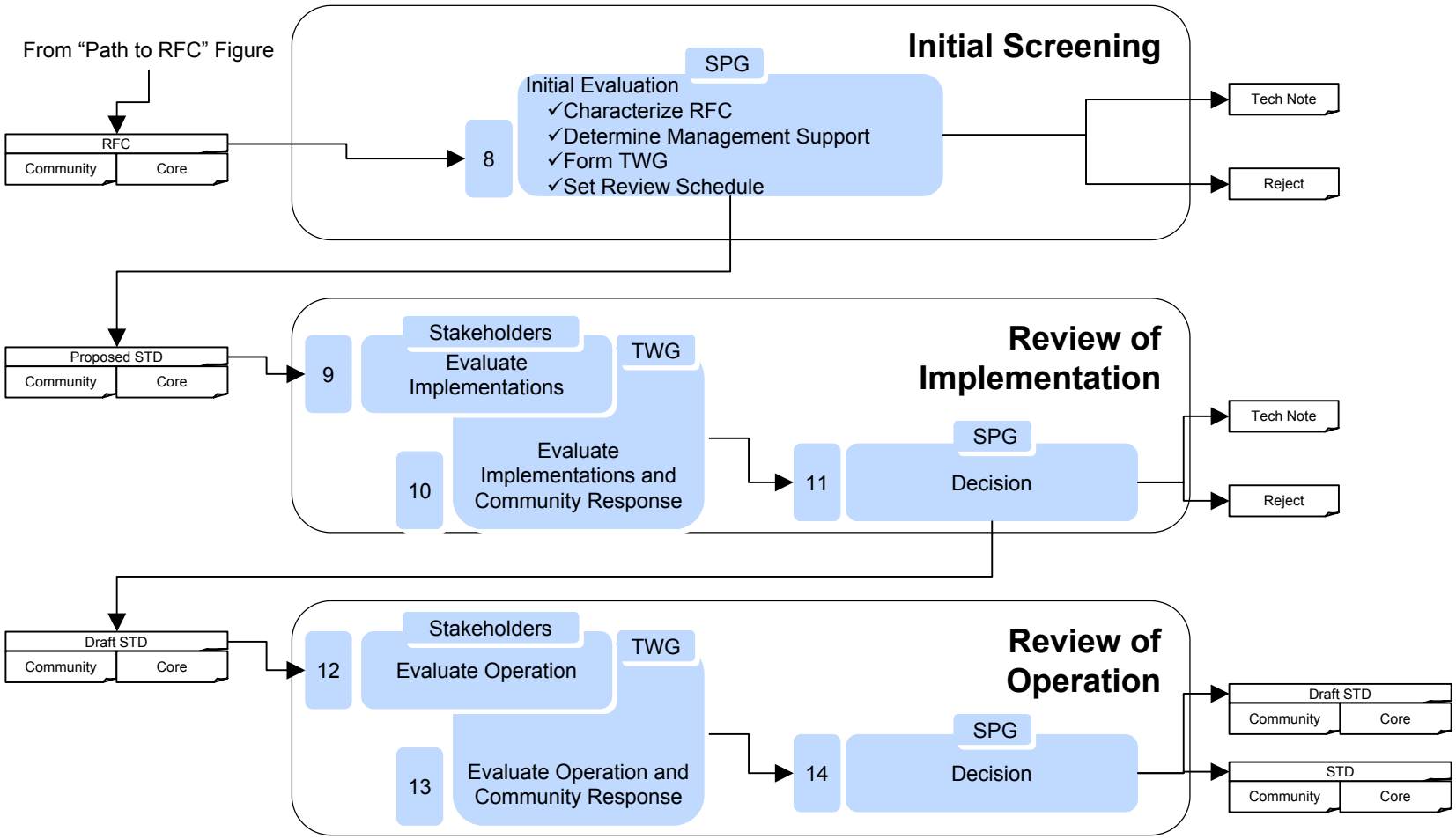
Path to RFC


NASA
1a
Agency articulates requirement
Stakeholders
1b
Science, Mission or Application articulates requirements
Stakeholders
1c
Propose standard
SPG
2
Vet requirements and determine applicability
RFC DOCUMENT
✓ New or adopted standard or profile of standard.
✓ Specific NASA Earth Science application.
✓ Implementation relevant to data systems (must have at least one operational implementation)
NASA
3
Issue RFI
Stakeholders
4
Public Reviews and Responds to RFI
To "Path to Approval" Figure
SPG
5
Decide whether to Adopt or Develop
LEGEND
See text for definitions of these groups
who
n
What happens in this step
…
Refer to text for description of step
SPG
6a
Recommend development of standard or profile
SPG
6b
Assign stakeholders to write RFC
NASA
7a
Agency development or procurement process
Stakeholders
7b
Document existing practice

Path to RFC: Directed or Organic Paths

- The ESDSWG Standards Process manages production and promotion of standards specification documents called “Requests for Comments” (RFCs). RFCs may be “directed” in response to identified NASA requirements or may arise “organically” from the community of stakeholders.
  - RFCs are directed in response to an identified need through a process of top-down analysis and solicitation via steps 1 through 7. The SPG will facilitate analysis of the requirement and solicitation of solutions. The SPG will assign a stakeholder to write and submit an RFC describing existing practice, or, if no appropriate standard exists, new development will be done via normal NASA development or procurement methods.
  - The organic path is shown as step 1c. This path short-circuits up-front analysis by the SPG. Standard RFCs flow directly from data systems stakeholders who will propose working standards based on their own implementation or experience.
- By either path, an RFC will be generated that defines or describes the standard and also specifies the data systems components or aspects to which the proposed standard would apply. The RFC will also list relevant implementation and operational references.

Path to Approval



Path to Approval: A Three-Phase Process

- RFCs are evaluated in three phases. Successful outcome at each phase results in advancement from "Submitted Standard" to "Proposed Standard" to "Draft Standard" to "Standard". management concurrence is required for promotion.
  - 1. The SPG first determines applicability to NASA science data systems goals and that materials necessary for review of the proposal and of reference implementations are available. The SPG forms a "Technical Working Group" (TWG), sets a schedule for review and releases the RFC as a " Proposed Standard". The SPG may otherwise reject the submission, or publish it as a "Technical Note."
  - 2. Stakeholders, broadly defined, may comment on the RFC. The TWG evaluates for technical soundness. After integrating community comments the TWG reports to the SPG. The SPG may recommend the RFC be promoted to " Draft Standard". Alternately, it may reject the RFC or publish it as a technical note.
  - 3. Again, stakeholders, the TWG and SPG review the RFC - this time for operational experience. SPG recommendation may be promotion to "Standard", or, the RFC may indefinitely remain as draft.

Impact accorded by status

- Submitted - No particular standing.
- Proposed - The SPG has affirmed that the proposed standard is applicable Draft - Working implementations of the standard have been demonstrated
  - NASA funded data systems activities should consider use of this standard where applicable.
- Standard - Significant operational experience has demonstrated value
  - Where applicable, NASA funded data systems activities should use this standard or else justify why not.
  - Use of this standard may be a requirement for future data systems awards.